make a call for reform in new qualifying methods more effectual.

And I would have it understood that the true end of all tutelary authority in government is the ultimate supreme authority of science in full hierarchal order, wherein man is constantly magisterial and institutions perfectly ministerial.

THE BASIS OF INDUCTION.

[Thesis Sustained Before the Faculty of Letters, in Paris].

BY J. LACHELIER.

Translated from the French by SARAH A. DORSEY.

Induction is the operation by which we pass from the knowledge of facts to that of the laws which govern them. The possibility of this operation is doubted by none; and yet on the other side it seems strange that some facts, observed in a time and place thus determined, should suffice to establish a law which may be applicable to all places and to all time. The best experience teaches at most only how phenomena connect themselves under our eyes; but that they should connect themselves in the same manner always and everywhere—that, no experience can teach us, and yet we do not hesitate to affirm this. How is such an affirmation possible, and upon what is it founded? This is the question, equally as difficult as it is important, which we mean now to essay to solve.

Apparently the most natural solution consists in pretending that our mind passes from facts to laws by a logical process, which does not confound itself with deduction, but which rests as deduction does upon the principle of identity. Without doubt a law is not logically contained in any portion, be it small or great, of the facts which it regulates; but it seems as if it might be contained at least, in the whole of these facts, in their totality —and we might even say that it does not in reality differ from this totality, of which it is only the abridged expression. If this

should be so, induction might be subject to some practical difficulties, but it would be in theory the simplest thing in the world. It would suffice to form, by force of time and patience, a complete collection of facts of each species. These collections once made, each law would establish itself by the institution of one term for several, and would then be above the shadow of all contestation.

This opinion seems to be that of Aristotle, if we judge him according to the celebrated passage of the Analytics, where he represents induction under the form of a syllogism. The ordinary syllogism, or at least that of the first form, consists, as everybody knows, in the application of a general rule to a particular case; but how is this rule to be demonstrated, when it is not itself contained in a still more general rule? It is here that intervenes, according to Aristotle, the inductive syllogism, whose mechanism he explains by an example. It is proposed to demonstrate that animals without galls live a long time. We know, or are instructed to know, that man, horses and mules, are the only animals without galls, and we also know that these three sorts are long lived animals. We can reason therefore thus:

Man, the horse, and the mule, live a long time. *Now*, the only animals without galls are man, the horse and the mule, *therefore*, all the animals without galls are long lived.

This syllogism is irreproachable, and does not differ essentially from ordinary syllogisms of the first form; but it differs in matter, in that the middle, instead of being a general term, is a collection of particular terms. Now it is precisely this difference which expresses the essential character of the inductive conclusion; because this conclusion consists, contrary to the deductive conclusion, in drawing from the complete collection of particular cases a general rule, which is only a resumé of the whole.

Whatever may be the bearing of this passage, it is easy to show that laws are not for us the logical result of a simple enumeration of facts. In truth, not only do we not hesitate to extend to the future laws which would represent at most under this hypothesis the totality of past facts; but a single fact carefully observed appears to us a sufficient basis for the establishment of a law, which at once embraces both the past and the future. There is then no conclusion properly so called, from facts to laws; hence the extent of the conclusion will exceed, and in most instances exceeds infinitely, the premises. Otherwise each fact is

contingent, considered in itself, and any sum of facts, however great, presents always the same character. A law, on the contrary, is the expression of a necessity, at least presumed; that is to say that it carries with itself the sequence that a certain phenomenon should follow or accompany such another, if always understood that we are not to take a simple coincidence for a law of nature. To conclude then from facts to laws, would be to conclude not only from the particular to the universal, but yet more, from the contingent to the necessary; it is therefore impossible to consider induction as a logical operation.

As to the authority of Aristotle, it is much less decisive upon this point than it appears at first to be. It is evident, in fact, that Aristotle did not seriously admit that man, the horse and the mule were the only animals without galls, nor that it was possible in general to arrange a complete list of facts, or of individuals of a determined species; the syllogism which he describes supposes therefore, in his thought, a preparatory operation, by which we tacitly decide that a certain number of facts or of individuals may be considered as representatives of an entire species. Now it is evident from one side that this operation is induction itself, and from the other that it is founded not upon the principle of identity, since it is absolutely contrary to this principle to regard *some* individuals as the equivalent of *all*. In the passage cited, Aristotle preserves silence upon this operation; but he has described it in the last page of his Analytics, with a precision that leaves nothing to be desired. "We perceive," he says, "individual beings, but the object proper to perception is the universal, the human being, and not the man called Callias." Thus from the avowal even of Aristotle, we conclude not from individuals to the species, but we see the species in each individual; the law is not for us the logical content of the fact, but the fact itself, seized in its essence, and under the form of universality. The opinion of Aristotle upon the passage of the fact to the law, that is to say, the essence itself of induction, is then directly opposed to that which we are disposed to attribute to him.

We are thus obliged to abandon the proposed solution, and to recognize that induction is not founded upon the principle of identity; this principle is, in truth, purely formal, that is to say, it truly authorizes us to announce under one form, what we have already announced under another, but it adds nothing to the contents of our knowledge. We have need, on the contrary, of a

principle in some sort material, which adds to the perception of facts, the double element of universality and necessity, which appears to us to characterize the conception of laws. To determine this principle we shall make now the object and end of our researches.

The existence of a special principle of induction has not escaped the notice of the Scotch school; but this school does not appear to have clearly seized the character and the value of it: "In the order of Nature," says Reid, "that which shall come, will probably resemble what has already come, under similar circumstances." This declaration is inexact, and "*probably*" is superfluous. For it is perfectly certain that a phenomenon which produces itself under certain conditions, will produce itself continually, whenever all these conditions shall be reunited afresh. It is true that the vulgar deceive themselves nearly always about these conditions, and that science itself has great difficulty to assign them exactly; from thence it comes that our attempts are so often deceived, and that we know perhaps no law of Nature which does not suffer from some exceptions.

In fact, induction is always subject to error; in law (droit) she is absolutely infallible. For if it is not certain that the conditions which determine to-day the production of a phenomena, will determine it to-morrow, the foresight founded upon an imperfect knowledge of these conditions would not even be probable. Royer Collard is more happy when he founds induction upon two judgments, of which one announces the stability and the other the generality of the laws which govern the Universe: but scarcely has he posited this double principle, before he compromises it, or rather destroys it by the strange commentary he adds to it. According to him, in truth these two judgments are neither necessary nor evident by themselves; the stability and generality of the laws of Nature are a fact for us, which we believe because it is so, and not because it would be absurd or impossible for it not to be so. But then who guarantees for us the existence of this double fact? Is it universal experience, or may it be, by chance, an induction anterior to that which it is requisite to explain? No, replies Royer Collard, it is our nature herself. It is difficult to imagine a more complete confusion of ideas. Our nature cannot instruct us *a priori* of a fact of experience; now outside of the experience of facts, there are for us only the truths of reason, of which the opposites are absolutely impossi-

ble. A judgment which is empirical, without being nevertheless necessary, is a veritable monster, which has no place in human intelligence. Reid seems to doubt his own principle. Royer Collard does not hesitate to pronounce, himself, the condemnation of his.

An illustrious savant of our day has formulated the fundamental axiom of Induction, in saying, that among living creatures as well as among bodies of dead matter, (*corps brut*), the conditions of existence of all phenomena are determined in an absolute manner. This expression is as just as it is precise, and explains perfectly how our minds can pass from facts to laws; for if each phenomena produces itself under conditions absolutely invariable, it is clear that it suffices to know what these conditions are in any case, in order to know by that only, what they should be in all. Only there is perhaps in nature room to distinguish two sorts of laws; the one applies to simple facts, as that which states that two equal and opposed forces will form an equilibrium; the others on the contrary announce between phenomena relations more or less complex, as that which declares that among living creatures the like will engender like. Nothing is less simple than the transmission of life, and it is certain that the formation of a new being demands a concourse of a prodigious number of physico-chemical actions. It is certain also that these actions do not always act themselves in the same way, because sometimes monsters are born from them. Now if we know only *a priori* that the same phenomena takes place under the same conditions, we should confine ourselves to affirming that the product of each generation will resemble its authors, IF all the conditions requisite are reunited; and whenever we pronounce contrarily, in absolute terms, that like engenders like, we evidently suppose, in virtue of some other principle, *that all the conditions are reunited*, at least in the majority of instances. It is this secondary principle which M. Claude Benard has, in some sort, personified in physiology, by calling it the *directing* or *organic idea* (idée directrice, ou organique); but it appears equally indispensable in brute matter as in organized beings. There is not, in fact, a single chemical law, which does not suppose, amidst the sensible phenomena whose relations it proclaims, the intervention of insensible phenomena whose mechanism is absolutely unknown to us; and to believe that this mechanism will act always in a way to produce the same results, is to admit in nature

the existence of a principle of order which watches, as we may say, over the existence of chemical species, as well as over that of living species. The conception of the laws of nature, with the exception of a small number of elementary laws, seems to be founded, therefore, upon two distinct principles: one in virtue of which the phenomena make a series in which the existence of the antecedent determines that of the successor; the other in virtue of which these series make in their turn, systems, in which the idea of all determines the existence of the parts. Now a phenomenon which determines another in preceding it, is what has been called from all time an efficient cause, and a whole which produces the existence of its own parts is, according to Kant, the true definition of a Final Cause. We are able to say then, in one word, that the possibility of Induction rests upon the double principle of Efficient Causes and Final Causes.

So far we have limited ourselves to the search after the principle in virtue of which we pass from the knowledge of facts to that of laws. Now that we think we have found it, it is needful to establish that this principle is not an illusion, but may conduct us to a veritable knowledge of Nature. In a word, it is necessary that the establishment of the fact should follow the demonstration of the law. To demonstrate a principle may seem in truth rather a bold enterprise, and it is one which the Scotch Psychology has not accustomed us to undertake. They say, not without appearance of reasonableness, that proof cannot go as far as the Infinite, and that we must indeed come to a certain number of truths absolutely first, which are the basis even of our thought, and which impose themselves upon us in virtue of their own self-evidence. But without speaking of the difficulty which one has always found in determining the number of these first truths, what right have they to affirm that a proposition absolutely denuded of proofs, is a principle which expresses the constitution of the mind and of things, and that it may not be a pure prejudice the result of education and of habit? They allege the impossibility in which we are of conceiving the contrary of these truths; but the question is always that of knowing if this impossibility belongs to the nature of things or to the subjective disposition of our thought; and the skeptics of to-day reply reasonably, that there has been a time when nobody believed that the earth turned around the sun. Without doubt it is absurd to suppose that principles may resolve themselves into

other more general principles which may serve them for proofs; for, either this resolution would go on to infinity, and the demonstration of principles would never be achieved, or it would end in a certain number of undemonstrable propositions, which would then be the veritable principles. But it is not necessary that all demonstration should proceed from the general to the particular; for even when the knowledge is most general in all, it remains still to be explained how this knowledge is found in our minds, and to be established also that it represents faithfully the nature of things. Now there is a means of resolving these two questions at once. It is to admit that our thought begins only in generalities and abstractions; and to seek, on the contrary, the origin of our knowledge in one or more concrete and singular acts, by which the thought constitutes itself by immediately seizing the reality. Either our science is but a dream, or the principles upon which it is founded are in their turn the expression of a fact, which is the fact even of the existence of the thought. It is then in this fact, and not in a primitive axiom, that we should essay to solve the principle upon which Induction rests.

It remains now to learn in what this first step consists, by which the thought enters into commerce with reality; and we are not able, it seems, to represent it to ourselves except in two ways, since contemporaneous philosophy admits only two definitions of reality itself. Either, in fact, reality consists exclusively in phenomena, and all knowledge is in the last analysis, a sensation; or reality is, in some sort, divided between phenomena and certain entities inaccessible to our senses, and in these cases human knowledge ought to burst forth at once from the sensible intuition of phenomena, and by a sort of intellectual intuition of these entities. We will go on then, adequately, in demonstrating the principle of Induction — from Experience, strictly so-called, to the intuition of things in themselves (choses en soi); and it is only in the event of discovering that neither of these two ways will lead us to the conclusion sought for, that we will deem ourselves authorized to try a third way.

II.

It is not necessary that we should essay to make for ourselves an empirical demonstration of the principle of Induction. This demonstration has already been given by Mr. Stuart Mill in his

System of Logic, and as we could not possibly hope to do this better than he has done it, we will content ourselves with the examination of this. We must recognize in advance that an enterprise of building upon sensible experience a proposition which pretends to the title of a principle, does not promise great chance of success, in spite of the skill of Mr. Mill; but the demonstration, even if insufficient, of a principle, after making all allowances against it, is of more value, and attests a thought more philosophic than the complete absence of all demonstration.

For the rest, it is easy to infer that the principle demonstrated by Mr. Mill is not precisely that which we formulated above, and presents neither exactly the same elements nor the same character. Rigorously speaking, there should be no more question in the philosophy of experience, of efficient causes than of final causes. For, if our senses do not teach us that a series of phenomena may be directed to a certain end, neither can they teach us any more, that each term in the series exerts upon the succeeding one any influence whatever. There is nothing to be astonished at in Mr. Mill's keeping absolute silence upon the finality we believe that we have discovered in phenomena; but in what sense can he say that one phenomena is cause of that which follows it, and thus found Induction upon what he calls the Law of Universal Causality? There is here a singular compromise between the exigencies of his system and the scientific tendencies of his mind. For, on one side he rejects as an illusion, all idea of a necessary connection, and in consequence all true causality; and, on the other, he does not hesitate to preserve the word and up to a certain point, the thing, in admitting between phenomena an order of succession absolutely invariable. Which constitutes, in fact, the most inflexible Determinism. He does not fear extending the empire of Determinism even so far as the human will; but he assures us at the same time that he does no wrong by this to free will, since the causes of our actions limit themselves to preceding them invariably, without exerting upon them any real influence. As to the character of the principle of Induction, there is evidently nothing in experience which could teach him that all phenomena *should* or *must* have an invariable antecedent, and his law of causality can only be the expression of a fact; but, fact or law, as it may be, what must we think of the universality which Mr. Mill attributes to it? We find here a second compromise stranger than the first, between the needs of

science and the logic of Empiricism. The law of causality is valuable, not only for our planetary system, but also for the group of stars of which our sun forms a part; it will be still in vigor not only in a hundred thousand years, but according to appearance, in a hundred million years; but beyond these limits, it may well be, that it will have the fate of the particular laws for which it serves as a basis, and that phenomena *may* succeed each other—as Mr. Mill expressly says—at hazard—that is an order of succession, contingent and limited to the phenomena upon which our thought can exert itself reasonably. Behold here definitely, all that the principle includes whose demonstration remains for us to examine. This demonstration seems to be very simple. We only know facts immediately, and the sole means through which we can distinguish general truths from these facts (that may be contained in them) is induction; the principle of induction then must be in itself the result of an induction, without there being a circle to apprehend in this. In fact, there are two sorts of induction; the one is the scientific induction, which consists in erecting into a law one single fact, well instanced, and which supposes evidently that every fact is the expression of a law; the other is vulgar induction, which proceeds by a simple enumeration of examples, which supposes nothing before itself, and which consequently may very justly serve as a basis for the principle which serves in its turn to justify the first. It is true that since Bacon, this latter form of induction is abandoned as a process without value; and it is certain that it wants in confidence when it concerns particular laws of nature, because here the enumeration can never be complete, and one hundred examples confirming it does not exclude the possibility of one hundred contrary examples. But it is not the same when it concerns the law of Universal Causality. As there is not a single case in which it may not be applicable, there has not been a single fact, since man has watched Nature, which is not called upon either to confirm or contradict it; and as it has been confirmed by all without being contradicted by a single one, it rests upon a complete enumeration, and possesses an irrefragable certitude.

If there is not a circle in this demonstration, there is at least a begging of question so manifest, that it is necessary to look twice before attributing it to a mind so penetrating as that of Mr. Mill. The enumeration of examples, they say, is never

complete for the particular laws of nature. Is it any more so for the laws of Universal Causality? Can we assure ourselves that this law may never be contradicted, even within the limits already so narrow, of human experience? Have not men believed a long time, following Mr. Mill himself, in a sort of partial and intermittent reign of chance? But in all these cases, the enumeration which he speaks of can only affect the past? Now it is needful to know whether the law of causality is valuable for the future, since this law should serve as a foundation for Induction, and that induction consists practically in a conclusion from the past to the future. We establish to-day a relation of succession between two phenomena, and we wish to know if the same relation will occur to-morrow. Yes, they say to us, because the phenomena have observed until now an absolutely invariable order of succession. But who knows whether they will be able to preserve it to-morrow? And if the particular laws of nature have need of being guaranteed by the law of universal causality, in what superior law shall we search for the guarantee of this law itself?

But we take ill, perhaps, the thought of Mr. Mill. He has not perhaps believed that the inference of the future from the past, illegitimate and impossible in itself, in each particular case, becomes possible and legitimate in virtue of a general rule, founded itself upon a similar inference. He is persuaded, on the contrary, that man makes the induction spontaneously, and without the aid of any principle. He declares expressly that the law of universal causality, far from preceding in our minds the particular laws of nature, follows and supposes them; and it is from these laws themselves that it draws, according to him, the authority which it needs in order to guarantee them. The spontaneous inductions which would suggest to the first men the regularity of the most ordinary phenomena, would not inspire them, really, with more than a mediocre confidence. They might believe, without being very sure of it, that all fire would burn and that all water quenches thirst; and when they are advised to reunite all these provisional laws under a common title, they have believed, without being more sure of it, that general phenomena are subjected to laws. But their confidence accrues naturally in the measure that experience confirms the result of their first inductions; and every fact which comes to confirm a particular law, deposes by that much in favor of the law of caus-

ality, which gathers thus to herself many favorable testimonies. as there are others collected. There is therefore nothing astonishing in that this law finishes by being invested with an absolute certitude, whilst others only attain by themselves to a degree of probability more or less elevated; and it is quite simple also that this certit ıde would react, in some sort, upon each one of these particular laws, of which the law of causality is at once the resumé and the sanction. The principle of induction reposes then, neither upon a sterile accumulation of past facts, nor upon a system of laws capable of sufficing to themselves; it is the last utterance of a spontaneous induction, whose results, more or less probable whilst they remain isolated, become certain in being concentrated in a single one. It is the key to the arch which crowns and sustains at once the edifice of science.

Thus understood, the theory of Mr. Mill contains neither circle nor a begging of the question (petitio principii); but it reduces itself to two arbitrary suppositions, of which the second is (what is more important) contradictory. We do not see, to begin, how the result of spontaneous induction, *only probable*, if you choose. in all that touches upon the particular laws of nature, can become certain when it concerns the law of universal causality. This law, it is said, governs so many phenomena, and therefore it is confirmed by experience more often than all the rest put together. Admit that the probability of induction increases by virtue of success and in ratio of it, the number of proofs of causality favorable to the law, will always be finite, and therefore not able to clear the infinite distance which separates probability from certainty. To say that this law succeeds in all cases, is the abuse of an equivocation; because this expression can only be extended evidently to the past, and in order that it may include all cases without restriction, it would have to be certain that there would be no more facts ever to come, and consequently no further inductions to make. In the second place, what is this spontaneous induction, and what place does it occupy in a system where experience is presented as the unique source of our knowledge? Is it then one and the same thing to observe the production of a phenomena, and to judge that the same phenomena will reproduce itself in the same circumstances? But this is not all: in supposing that from the first observation (for the hundredth will not teach us any more on this point) men have a right to conclude from the past to the

future, how is it that this conclusion was only probable at first? From two things come really one; either at the moment of this first observation, their minds contain nothing more than the perception of an external fact, and there is nothing in this perception which could suggest the lightest anticipation of the future: or, to this perception they add, drawing apparently from their own recesses, the conception of a durable nexus between phenomena, and this conception, as all *a priori* judgment, had an absolute value, which the ulterior results of experience can neither add to nor diminish.

There is a means of escape from all these embarrassments; but as this means is not expressly indicated in the work of Mr. Mill, we can only propose it, without knowing whether the illustrious author would have consented to subscribe to it. Suppose first, that induction (spontaneous) is not a judgment declared by our thought upon the objective succession of phenomena, but a subjective disposition of our imagination to reproduce them in the order in which they have struck our senses. It may be granted without overleaping the limits of Empiricism, that this disposition, at first purely virtual, would develop in us under the influence of our first sensations; and we conceive at the same time that, feeble in its debut, it would be incessantly fortified by the invariable order in which all our sensations follow each other. Suppose in the second place, that probability consists for us in a powerful habit of the imagination, and certainty in an invincible habit; the passage from probability to certitude has no more, in its turn, anything of the inconceivable, *provided* that we do not attach too absolute a sense to the word *invincible*, and that we acknowledge that our belief in universal causality, founded on a prodigious number of impressions (confirmatory), may be shaken in the course of time by a repeated shock of contrary impressions. Logic in this case has nothing more to say; but what becomes of the science, that is to say, the objective knowledge of nature? Will Mr. Mill say that he does not admit the vulgar distinction between nature and our thought, that is to say, between the system of our sensations and a system of things in themselves (choses en soi)? But that which holds the place of nature in his doctrine, is our actual sensations, and not their traces which they leave after them in our imaginations. They are these sensations and not their images, between which science ought to establish the connection and foresee the return. Now because we have adopted

the habit of associating in a certain order the images of our past sensations, does it follow that all our future sensations should follow in the same order? This interior nature, whose course does not order itself according to the play of our imagination, does it not escape from us in the same way as the external nature in which the vulgar believe? And the sequel of this theory—is it not pure skepticism, which destroys all reasonable foresight, and leaves us only a mechanical prudence like that of animals?

For the rest, whether Mr. Mill desires it or no, it is certain that skepticism is the natural fruit, and the ever renewed fruit of Empiricism. If nature is only for us a series of impressions, without reason and without connection, we can readily establish these, or rather submit to them at the moment they are produced; but we can neither predict, nor even conceive the future production of them. That which Empiricism calls our thought, by way of opposition to nature, is only a whole of enfeebled impressions which survive of themselves; and to search for the secret of the future in that which is the vain image of the past, is to undertake to discover in a dream what will happen to us during our waking hours. We wish to settle induction upon a solid basis. Do not let us search for her longer in a philosophy which is the negation of science.

[To be concluded in the October number.]

ANTHROPOLOGY.

Translated from the German of Immanuel Kant, by A. E. KROEGER.

CONCERNING THE FIVE SENSES.

§13. Sensuousness in the faculty of cognition — the faculty of representations in contemplation—comprises two parts: Sense and the power of imagination. The former is the power of contemplating in the presence of the object; the latter is the power of contemplating also without that presence. But the senses are